

Alaska Department of Fish and Game  
Division of Wildlife Conservation  
December 2001

# Physiological Ecology of Moose: Nutritional Requirements for Reproduction with Respect to Body Threshold Conditions

Thomas Stephenson

Research Performance Report  
1 July 2000–30 June 2001  
Federal Aid in Wildlife Restoration  
Grant W-27-4, Project 1.52

This is a progress report on continuing research. Information may be refined at a later date.

If using information from this report, please credit author(s) and the Alaska Department of Fish and Game.

**FEDERAL AID**  
**ANNUAL RESEARCH PERFORMANCE REPORT**

ALASKA DEPARTMENT OF FISH AND GAME  
DIVISION OF WILDLIFE CONSERVATION  
PO Box 25526  
Juneau, AK 99802-5526

**PROJECT TITLE:** Physiological Ecology of Moose: Nutritional Requirements for Reproduction with Respect to Body Condition Thresholds

**AUTHORS:** Thomas R. Stephenson, John A. Crouse, and Kris J. Hundertmark

**COOPERATORS:** Kenai National Wildlife Refuge

**GRANT AND SEGMENT NR.:** W-27-4

**PROJECT NR.:** 1.52

**SEGMENT PERIOD:** 1 July 2000–30 June 2001

**WORK LOCATION:** Kenai Moose Research Center, Soldotna

**STATE:** Alaska

---

**I. PROGRESS ON PROJECT OBJECTIVES**

**OBJECTIVE 1:** Determine overwinter nutritional requirements for reproductive success in female moose.

We formulated multiple rations to simulate natural diets with varying levels of energy and protein. Using a controlled access feeding system, we applied nutritional treatments to cow moose and quantified changes in body composition throughout the year.

**OBJECTIVE 2:** Determine thresholds in body condition at which reproductive performance declines.

Using ultrasonography, we diagnosed pregnancy status and calf viability in cow moose exposed to various nutritional treatments.

**OBJECTIVE 3:** Evaluate the existence of cumulative effects in female moose relative to body condition, reproductive performance, and nutrition.

Using a repeated measures design, we quantified moose body condition, litter sizes, and calf mass as well as metabolizable energy intake.

**OBJECTIVE 4:** Refine estimation of moose body composition using ultrasonography.

We continued to refine ultrasonographic measures of fat and muscle thickness for quantifying energy and protein reserves. In addition, a new cutaneous palpation scoring method shows promise for quantifying body fat in very lean animals.

OBJECTIVE 5: Using ultrasonography and a quantitative serum assay, develop and refine methodology for diagnosing twinning in moose.

Two manuscripts have been published: 1) Isolation, purification, and characterization of pregnancy-specific protein B from elk and moose placenta. 2) A serum pregnancy test with a specific radioimmunoassay for moose and elk pregnancy-specific protein B.

OBJECTIVE 6: Evaluate effects of density dependence on body condition, reproductive performance, and diet quality of moose on natural browse.

Captive and free-ranging moose were examined to quantify the role of habitat quality and animal density on nutritional condition.

## **II. SUMMARY OF WORK COMPLETED ON JOBS IDENTIFIED IN ANNUAL PLAN THIS PERIOD**

JOB 1: Conduct feeding trials to evaluate the relationship between moose nutrition, body condition, and reproductive performance.

We continued to quantify body condition and in utero fetal rates of cows on various nutritional treatments. We established relationships among initial body condition during fall, metabolizable energy intake, and change in body condition during winter. Adult females entering winter with depleted fat reserves exhibited high intake rates throughout winter when offered feed ad libitum. Hence, the ability to recover condition following the demands of reproduction is directly related to the duration of availability of high quality forage and, in free-ranging moose using optimal habitats, may extend well into winter.

JOB 2: Evaluate relationship between calf health and the dam's nutrition and body condition.

To date, 2 related manuscripts have been produced that are in press: 1) Vitamin E, selenium, and reproductive losses in Alaskan moose. 2) Nitrogen and carbon isotope fractionation between mothers, neonates, and nursing offspring. In addition, we describe the mathematical relationship between maternal body condition and likelihood of twinning using logistic regression. We also observed a strong relationship between maternal condition and neonatal calf mass.

JOB 3: Validate approaches for determining body fat and body protein in live moose.

Carcasses and live moose were used in the evaluation of ultrasonography and a cutaneous palpation scoring method for improving estimates of body fat in lean animals. Samples are currently undergoing chemical analysis.

JOB 5: Monitor Density Effects on Body Condition and Reproductive Performance.

Pens at the Moose Research Center containing forage densities representing early and late successional forest were stocked with low densities of moose. We quantified changes in body condition overwinter in response to differing levels of forage availability. Diet quality and plant architecture were quantified by directly observing foraging behavior of habituated cow moose. Frequent GPS locations were obtained to determine the effects of forage density on animal movements and activity.

Free-ranging moose in numerous populations across the state of Alaska were handled during collaborative projects. We examined body condition in relation to lactation status, in utero fetal numbers, habitat quality, and winter severity. We measured body fat in free ranging radio-collared moose during repeated years in 8 populations distributed across the state of Alaska. Total body fat ranged between <5% and 20% (the apparent physiological maximum). Body fat reserves were depleted in individuals in high-density populations or those experiencing maturing habitat conditions.

**III. ADDITIONAL FEDERAL AID-FUNDED WORK NOT DESCRIBED ABOVE THAT WAS ACCOMPLISHED ON THIS PROJECT DURING THIS SEGMENT PERIOD**

none

**IV. FEDERAL AID TOTAL PROJECT COSTS FOR THIS SEGMENT PERIOD**

\$ 93,700

**V. PREPARED BY:**

Thomas R. Stephenson  
Wildlife Biologist III

**APPROVED BY:**

\_\_\_\_\_  
Steven R Peterson, Senior Staff Biologist  
Division of Wildlife Conservation

**SUBMITTED BY:**

Donald Spalinger  
Research Coordinator

\_\_\_\_\_  
Wayne L Regelin, Director  
Division of Wildlife Conservation

**APPROVAL DATE:** \_\_\_\_\_